NOTICE

All drawings located at the end of the document.

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Final Mound Site Plume Project Completion Report, Fiscal Year 1998

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Environmental Restoration
Rocky Flats Environmental Technology Site

May 1999

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FINAL

MOUND SITE PLUME PROJECT

COMPLETION REPORT
FISCAL YEAR 1998

Rocky Flats Environmental Technology Site
May 1999

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FIGURES

ACRONYMN LIST

ASTM	American Society of Testing and Materials
CCl_4	Carbon Tetrachloride
DOE	Department of Energy
EPA	U S Environmental Protection Agency
gpm	Gallons Per Minute
HDPE	High Density Polyethylene
ID	Inside Diameter
NPT	Nominal Pipe Thread
OD	Outside Diameter
PID	Photoionization Detector
PCE	Tetrachloroethene
PVC	Polyvinyl Chloride
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services
SDR	Standard Dimension Ratio
SITE	Superfund Innovative Technology Evaluation
TCE	Trichloroethene
VOC	Volatile Organic Compound

1 0 INTRODUCTION

This report documents the completion of the Mound Site Plume Project at the Rocky Flats Environmental Technology Site (RFETS) This project was conducted in accordance with the Mound Site Plume Decision Document (DOE 1997) Contaminant concentrations are in excess of the Action Level Framework Tier II level groundwater concentrations defined in the Rocky Flats Cleanup Agreement (RFCA) (DOE 1996) The objective of installing a subsurface groundwater collection and treatment system for the Mound Site plume was to capture contaminated groundwater at the distal end of the plume, and as a result, to minimize contaminant impacts to surface water quality in South Walnut Creek

The Mound Site Plume Project employs an innovative technology for the collection and treatment of groundwater contaminated with chlorinated organic compounds and low levels of radionuclides This project was a cooperative effort between the RFETS and the Department of Energy (DOE) Subsurface Contaminant Focus Area (EM-50), with support from the National Risk Management Research Laboratory of the US Environmental Protection Agency (EPA)

The Fiscal Year 1998 work scope for the Mound Site Plume Project included installation of a 230-foot below-grade impermeable-barrier collection system along with two treatment cells Installation of the collection and treatment system was completed on September 18, 1998 The EPA Superfund Innovative Technology Evaluation (SITE) program began effluent sampling on October 28, 1998 after it was agreed that much of the tap water emplaced in the reactor vessels during construction and repair activities had been displaced by contaminated groundwater

This completion report discusses the specifics of the system installation and provides as-built drawings for use in operation and maintenance activities and system modifications

1 1 Technology Description

The remedial approach utilizes a barrier membrane to capture, redirect, and treat contaminated groundwater and treatment cells containing zero-valent iron to provide treatment The collection and treatment system for the Mound Site Plume Project consists of

- A single-membrane, impermeable containment barrier (i e high-density polyethylene [HDPE]), that extends approximately 230 feet (see Figures 1 and 2) The impermeable membrane barrier is keyed into the underlying bedrock located approximately 10 to 16 feet below ground surface (bgs) The upgradient side of the membrane was backfilled with a graded filter material that conforms to American Standard of Testing and Materials (ASTM) C33 for Concrete Sand

- A four-inch perforated HDPE pipe was placed in the granular filter media backfill and piped to a central collection sump Sand and pea gravel were back-filled over the pipe to enhance infiltration into the pipe The sump is piped to two treatment cells located downgradient of the barrier and collection system

- Zero-valent iron in two sub-grade treatment cells is used to remediate the volatile organic compounds (VOCs) and radionuclide contaminated groundwater to below the Tier II Action Level Framework levels concentrations as defined in RFCA (DOE 1996)

- Treated water is discharged back into the groundwater on the downgradient side of the treatment cells through a French drain

- Five monitoring points were installed in the collection trench for performance monitoring of the system

The purpose of this project was to demonstrate the effectiveness of a passive groundwater collection and treatment system in removing both VOC and radionuclide contaminants from groundwater Groundwater is collected in the porous media upgradient of the impermeable membrane and directed into a single collection sump The captured groundwater is passively funneled from the collection sump through treatment media contained in two below-grade treatment cells After treatment, the groundwater is discharged downgradient back to the water table through a french drain The french drain also has an overflow line that discharges directly to surface water

As the water passes through the treatment media, the reactive iron destroys the volatile organic compounds Radionuclides in the groundwater are removed by chemical reduction and/or absorption and remain on the iron matrix The treatment cells were designed so that treatment media can be easily removed and retrieved to allow the extraction of bound contaminants and replenishment of the reactive media

2.0 PROJECT BACKGROUND

The Mound Site Plume project is located north of Central Avenue and east of the RFETS Protected Area along the southern edge of the South Walnut Creek Drainage The Mound Site was a drum storage area where 1,405 drums of uranium and beryllium contaminated lathe coolant (a mixture of approximately 70% hydraulic oil and 30% carbon tetrachloride [CCl_4]) were placed between 1954 and 1958 Some drums also contained tetrachloroethene (PCE) Historical information also indicates that some of the coolant contained low levels of plutonium (DOE 1992) The drums were removed in 1970, but 10% of the drums were suspected to have leaked However, there are no records of the volume of contaminants released to the soil at the Mound Site Radioactively contaminated soils were previously removed from the Mound Site and removal of VOC contaminated soil was completed in 1997

The ground surface slopes steeply to the north away from the Mound Site towards the incised drainage of South Walnut Creek VOC contaminated groundwater is found in monitoring wells between the Mound Site and South Walnut Creek, which indicates that the Mound Site is the primary source area for the plume While thirty-five VOCs have been detected in the plume, PCE and trichloroethene (TCE) are the dominant contaminants PCE is the predominant contaminant with historical concentrations as high as 528,000 micrograms/liter (ug/l) found in well 0174 at the Mound Site while the highest TCE concentration detected was 18,000 ug/l Concentrations of these chemicals decrease towards South Walnut Creek, however, groundwater samples collected confirm that VOC contaminated groundwater is present in localized areas near the South Walnut Creek Drainage

3 0 INSTALLATION OF GROUNDWATER COLLECTION SYSTEM

The collection system was placed to optimize groundwater collection (see Figure 1) A land survey was conducted prior to commencement of construction work at the site The barrier wall was aligned by placing stakes at 25-foot intervals along the entire length with 25-foot offsets Survey tolerances were maintained to within ±2 inches Survey reference points were also identified and placed outside of the construction area and used as reference points during construction

The Mound Site plume collection system is oriented generally in an east-west configuration The collection system was installed to below the weathered/unweathered bedrock interface, a depth of approximately 10 to 16 feet bgs The bottom of the barrier was sealed into the upper portion of the bedrock with a bentonite seal in order to limit groundwater flow beneath the barrier A bentonite seal was also installed at the west end to minimize groundwater flow around that end of the barrier wall Construction activities began on June 4, 1998 and were mostly completed by July 15, 1998 Leak detection and repairs began on July 16, 1998 and were completed by August 28, 1998 Between November 30, 1998 and December 10, 1998, additional repairs were conducted to fix broken influent pipes at the bulkhead fittings at each the two treatment cells Two valves were also replaced Upon completion of the repairs the system was leaked tested and put back into operation

Prior to trenching or excavation, a minimum of 12 inches of material at the surface was removed from the areas where construction would be taking place In some cases up to three feet of material was moved to establish a level, safe working platform The top soil was segregated and stockpiled to be used as final cover after completion of construction activities

The barrier wall was constructed of 100-millimeter HDPE sheets fitted with an interlocking strip on each side To assist in installation, the HDPE sheets were fixed to steel support structures to give the panels rigidity and weight The panels were 15 feet wide and 15 to 20 feet long depending on the required depth at any given location The bottom of each panel had two "channels" that slid onto centralizers located at the bottom of each steel frame The tops of the panels were rolled back and bolted to create a hem through which a steel bar could be inserted Winches were then attached to the steel bar and to the top of the steel structure to stretch the panels tight against the steel frame The "bottom channels" allowed the steel frames to be lifted off the HDPE sheets once the winches were removed

The trench was initiated at the east end of the alignment (Station 2+75) Enough trench was excavated to allow two or three panels to be placed, and then the cranes were positioned to place the HDPE panels The panels were lifted and placed using a light duty crane (25 tons) After the crane placed a panel, a boom truck would support the panel vertically while the crane lifted the next panel into place Personnel working from a man-lift positioned over the trench would thread the interlock of the next panel to the barrier system After a panel was lowered into place, a bolt was used to secure the panel to the previously placed panel and the boom truck would be positioned to support the panel The crane would then be attached to the previous panel, the winches would be removed and the steel structure was removed to have another HDPE sheet attached As the steel frames were removed from the HDPE panels, the sheets would be pulled tight along the downgradient side of the trench and staked in place

The HDPE barrier wall was constructed continuously from the eastern most end of the alignment (Station 2+75) to the western most end of the alignment (Station 0+45) Once the sheets were in place, a geofabric was draped against the HDPE sheets to within one foot of the bottom of the trench The bottom

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of the trench was backfilled with two feet of bentonite to seal the bottom of the HDPE sheets and limit the potential for underflow of groundwater around the barrier system The bentonite was delivered to the site in "super sacks" and placed using the crane Personnel in the man-lift directed the placement of the bentonite and used a rake attached to an extension handle to smooth the bentonite layer and check finished elevations

Once the bentonite was in place, the geofabric was moved to the upgradient side of the trench to separate the bentonite and native undisturbed soils from the filter media backfill The trench was then backfilled with approximately 4 inches of a silica based, non-reactive coarse sand filter media On top of the base layer of filter media, a 4-inch perforated HDPE collection pipe was placed The collection pipe was installed with a filter sock to prevent fines from entering the pipe, and solid pipe was extended to the surface at each end of the trench to provide clean-out stations for maintenance purposes

The filter media was backfilled to approximately 3 feet from grade, the geofabric was folded over the filter media, and then the rest of the trench was backfilled and capped with the native material excavated during trenching operations One penetration through the barrier wall was installed for a 2-inch HDPE pipe that connects the collection sump to the treatment system This penetration was made after sufficient backfill was placed to allow safe entry into the excavation

The manhole sump, or collection sump, provides a central collection point for groundwater captured by the geomembrane barrier and collection system The perforated collection piping is plumbed into a 48-inch (outside diameter [OD]) collection sump, located on the upgradient side of the barrier wall Groundwater collected in the sump flows by gravity to the treatment cells located down the slope from the vault The sump is constructed of HDPE and was pre-constructed off-site The collection sump was engineered to allow personnel entry into the sump for service or maintenance

When the excavation reached the collection sump location (Station 1+70), a level foundation on bedrock/claystone for the collection sump was excavated The bottom of the excavation was prepared with approximately one foot of the same backfill material used in the trench, over undisturbed soil, to structurally support the sump The 4-inch perforated collection pipe was bolted to the inlet flange on the collection sump prior to lowering the sump into place Once the sump was placed, the perforated collection pipe was lowered into the eastern portion of the trench that had already been prepared with filter fabric, bentonite, and four inches of filter backfill material

Prior to backfilling around the sump, the sump was filled with water to provide structural support during compaction of the backfill materials Backfill material consisted of the same backfill filter material used in the trench Once the backfill material reached the top, or overflow flange, the 2-inch discharge pipe connecting the collection sump to the reactor vessels was bolted to the sump and the barrier wall penetration was installed and tested Details of the groundwater collection system are shown on the as-built drawings (Figures 1 and 2)

4 0 INSTALLATION OF TREATMENT SYSTEM

The groundwater collected by the barrier wall collection sump flows by gravity to two treatment cells, followed by a metering manhole, with final discharge to a french drain The treatment system components and installation procedures were detailed in the Mound Site Plume Construction Specifications and Drawings

The treatment system components are all below grade and installed in an excavation constructed with the sides of the excavation cut to a 1 5 (horizontal) to 1 (vertical) slope Entrance into the excavation was required to install the reactors, metering manhole, french drain, interconnecting HDPE piping and valves, and valve boxes After the excavation was completed, the pads for the reactors and metering manhole were prepared by placing approximately one foot of the filter backfill material used in the collection trench on undisturbed bedrock/claystone to obtain the required final elevations After the pads were leveled, the vessels, piping and valves were installed

The piping from the collection sump to the treatment cells and finally to the french drain was constructed using 2-inch HDPE pipe with a standard dimension ratio (SDR) of 17, meeting ASTM D3350 The pipe was assembled on site using a butt-fusion thermal welding machine, flanges, and threaded transition fittings HDPE or polyvinyl chloride (PVC) flanges were used to connect the piping to the treatment cells and metering manhole All connections to valves were made with threaded adaptors that are constructed of HDPE fused to steel male Nominal Pipe Thread (NPT) threaded ends

True union PVC ball valves with threaded connections were used to direct the flow of water to each of the system components, or to by-pass components for maintenance activities Valve handle extensions were made in the field based on the final backfill grade and installed in each valve box The bottom layer of treatment system piping was bedded in at least 4 inches of filter backfill material (pea gravel) prior to being backfilled with additional pea gravel Concrete pavers were placed under each valve to support the cast-iron valve boxes The valve boxes are screw-type adjustable boxes with bell ends The piping and valve boxes were backfilled by hand with pea-gravel to maintain the position of the pipes and valves Prior to starting the backfill operation, the reactors were filled with water to provide the vessels with increased structural strength to withstand the backfilling activities

The reactor vessels are 119 inches in diameter and 138 inches tall and are constructed of HDPE with a nominal wall thickness of 1-inch A 2-inch inlet and outlet flange was installed on each tank at the factory using nitrogen gas hand bead weld The outlet flange is located 7 inches from the bottom of the vessel, and the inlet flange is located 79 inches from the bottom of the vessel Prior to installation, four ½-inch holes were tapped into the side walls of each vessel and fitted with PVC sample ports that extended to the top of the vessels Each reactor has a 72-inch square opening in the top for access of personnel and installation and removal of the treatment media The door frame is reinforced with 6-inch by 8 3 pound steel channel, and the opening is outfitted with twin fixed hinged aluminum access doors

After backfilling was complete, the reactors were drained and filled with the approximately 30 tons of reactive iron treatment media Each reactor was filled from the bottom as follows

- One foot of permeable filter gravel,
- One layer of geotextile fabric,
- Four feet of granular iron, and
- One foot of a 50/50 iron/pea gravel mixture

This configuration yields a four-foot granular iron reaction zone in each of the two treatment cells A collection manifold constructed of 2-inch PVC 0 10-slot well screen was placed in the bottom layer of filter gravel and connected to the discharge pipe Slotted PVC sampling tubes were installed in the iron media at one-foot intervals and were connected to the ½-inch taps installed on the sides of the treatment reactors A 4-foot railing was provided around the opening in the top of each of the treatment reactors

The iron was in 1 5 ton super sacks with lifting straps and a dispensing chute on the bottom of the sack The iron was placed into the reactors using a crane to lift the super sacks and by opening the chute in the bottom of the sacks The iron/pea gravel mixture for the top 1-foot of material in the reactor was mixed on site using a cement truck and loaded into the reactors using the dispensing chute Each layer in the reactors was leveled using rakes and shovels by personnel either lowered into the vessels, or from the top of the tank using handle extensions All entries into the vessels were performed by trained personnel under confined space entry permits

The metering manhole is glass-fiber-reinforced polyester and conforms to ASTM D 3753 The metering manhole is a 4-foot inside diameter (ID) vessel, 9-feet 6-inches deep with a dome top It includes a FRP ladder, and has a 2-inch inlet and outlet fitting The bottom of the manhole contains a 0 4-foot HS flume designed to measure flows of 0 1 to 2 5 gallons per minute (gpm) An ISCO Model 4210 Ultrasonic Flow Meter is mounted above the flume to measure and totalize the flow of treated groundwater The flow meter provides a local readout of the depth of water in the flume, instantaneous flowrate, and totalized flow to date It is programmed to print reports and electronically store the data The flow meter is powered by a lead-acid battery connected to a solar battery charger

The french drain is constructed out of a 10-foot length of 24-inch diameter, HDPE perforated, corrugated drain pipe The bottom of the french drain is fitted with a screen and is surrounded by ¾-inch to 1½-inch crushed stone to promote infiltration into the ground The drain has two influent penetrations, one from the metering manhole and one from the treatment cells The drain has one effluent penetration for overflow to South Walnut Creek Details of the groundwater collection system are shown on the as-built drawings (Figures 3 and 4)

5.0 INSTALLATION OF COLLECTION TRENCH GROUNDWATER MONITORING PROBES

Five trench water-level monitoring probes were installed in the collection trench during backfilling operations Well materials consist of one-inch ID schedule 40 PVC flush-threaded casing, with a two-foot length of factory slotted (0 010 inch) casing with bottom cap The completions include a bentonite seal of 0 25-inch pellets, cement-bentonite or high-solids bentonite grout, concrete surface pad, and protective cover (stick-up design) The protective casings are painted white The locations of the water level monitoring probes are shown on the as-built drawings (Figure 1)

Seven piezometers for monitoring upgradient and downgradient water levels were installed and completed on January 7, 1999 Approximate depths to the bottom of the sump casings are 12 to 13 feet below grade Well materials consist of two-inch ID schedule 40 PVC flush-threaded pipe casing, with a five-foot length of continuous factory slotted (0 010 inch) screen The completions include a silica sand (16-40 gradation) filter pack, bentonite seal of 0-25-inch pellets, cement-bentonite or high-solids bentonite grout, concrete surface pad, protective cover (stick-up design), and a metal identification tag The locations of the piezometers are shown on the as-built drawings (Figure 1)

Eleven temporary wells were abandoned The wells were constructed of 1-inch ID PVC casings The two-inch diameter PVC protective top casing, which were set to approximately 1 5 feet bgs, were pulled, and the well casings were filled with 0 25-inch bentonite pellets hydrated in two-foot lifts as described in the Rocky Flats Well Abandonment Standard Operating Procedure Temporary wells located within the area of excavation were removed entirely

6 0 AS-BUILT DRAWINGS

The following as-built drawings are included with this completion report

- Figure 1 - Barrier Wall and Treatment System Locations
- Figure 2 - Collection Trench Profile
- Figure 3 - Treatment System Piping Layout
- Figure 4 - Treatment Cell

7.0 WASTE MANAGEMENT

Soils removed from the trench and excavated areas were stockpiled within the trench area where the topsoil had been removed Soils were routinely field screened as they were excavated using a photoionization detector (HNU) No soils had detectable concentrations of VOCs As a result, all excess soil generated was graded over the trenched area and revegetated

During construction of the collection trench and barrier wall, saturated soils were not encountered with the exception of soil at two pre-existing french drains near the west end of the trench The quantity of water encountered at the pre-existing french drain locations was contained within that area of the trench and did not require pumping to a holding tank The majority of the soils excavated were very dry

Workers wore coveralls and clothes provided by Rocky Flats No personal protective equipment waste was generated during the construction activities Miscellaneous debris encountered during the construction including a bunker that existed in the area and other structures was segregated for disposal by Rocky Mountain Remediation Services (RMRS) All other construction debris was loaded into roll-off bins delivered to the site for disposal at the landfill

No spills occurred during the construction phase of the project

8 0 SITE RECLAMATION

Top soil stockpiled during grubbing and excavation activities was uniformly replaced to an approximate depth of 6 inches The topsoil, once replaced, was roughly graded to prepare for revegetation A revegetation contractor disked, seeded, and mulched the disturbed area The standard seed mixture specified by the RFETS Ecology Group was applied

9 0 DEVIATIONS FROM THE DECISION DOCUMENT

Figure 10 in the decision document (DOE, 1997) illustrated three treatment cells on concrete slabs Section 4 1 2 of the decision document stated that the treatment system would be designed based on the results of the laboratory treatability studies During the treatment system design, it was determined that two cells would be sufficient to hold the required media volume with the retention times determined by the treatability studies In addition, during the system design, it was also determined that concrete slabs were not necessary for the treatment cells as these were installed on competent bedrock claystone in a dry area These changes were not considered deviations from the intent of the Decision Document There were no other deviations from the decision document The upgradient and downgradient wells specified in the decision document have been installed as shown in Figure 1

10.0 REFERENCES

DOE, 1992, *Final Historical Release Report for the Rocky Flats Plant*, 21100-TR-12501 01, Rocky Flats Plant, Golden, CO, July

DOE, 1996, *Final Rocky Flats Cleanup Agreement*, Rocky Flats Environmental Technology Site, Golden, CO, July

DOE, 1997, *Final Mound Site Plume Decision Document*, RF/RMRS-97-024, September

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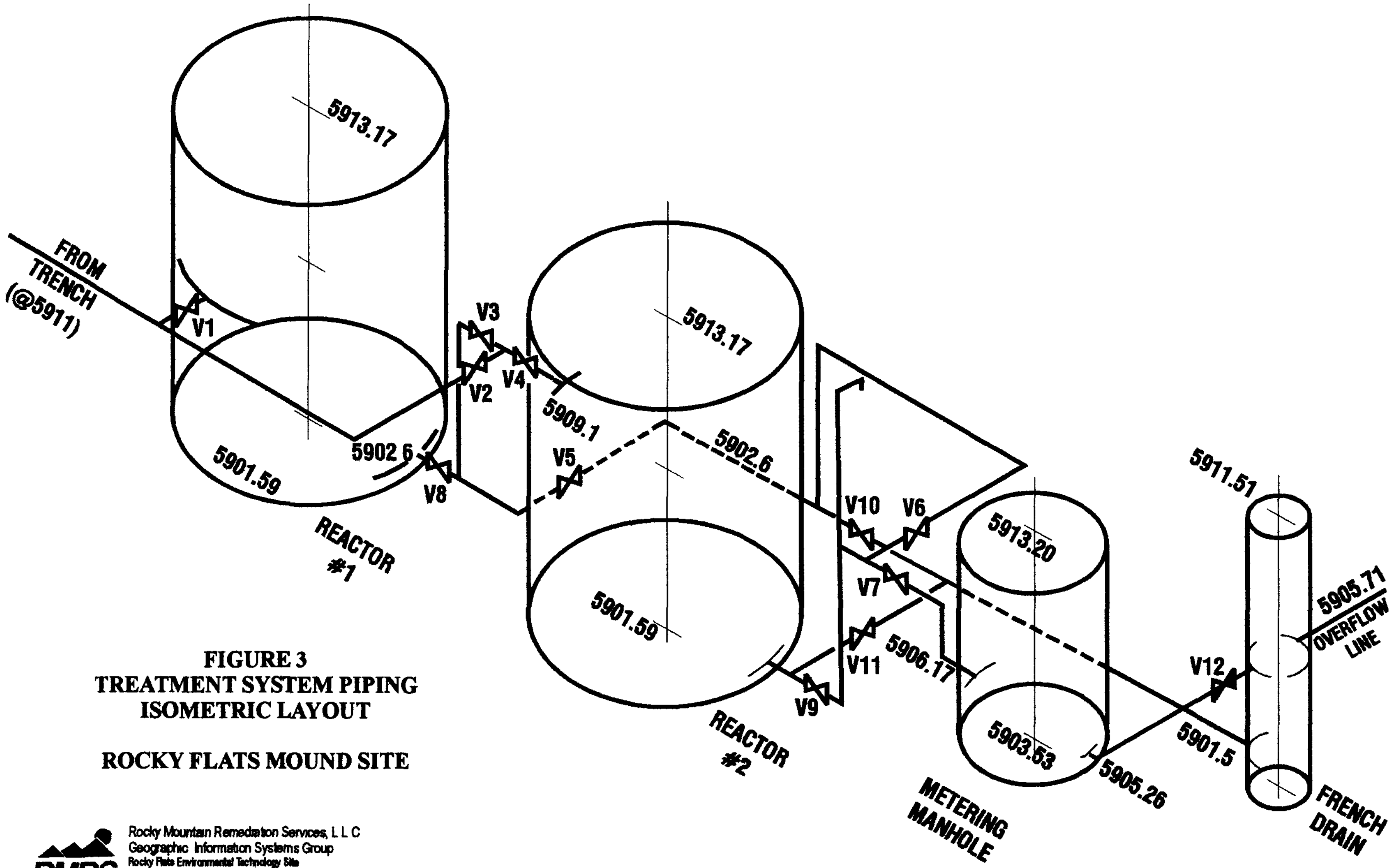

FIGURE 3
TREATMENT SYSTEM PIPING
ISOMETRIC LAYOUT

ROCKY FLATS MOUND SITE

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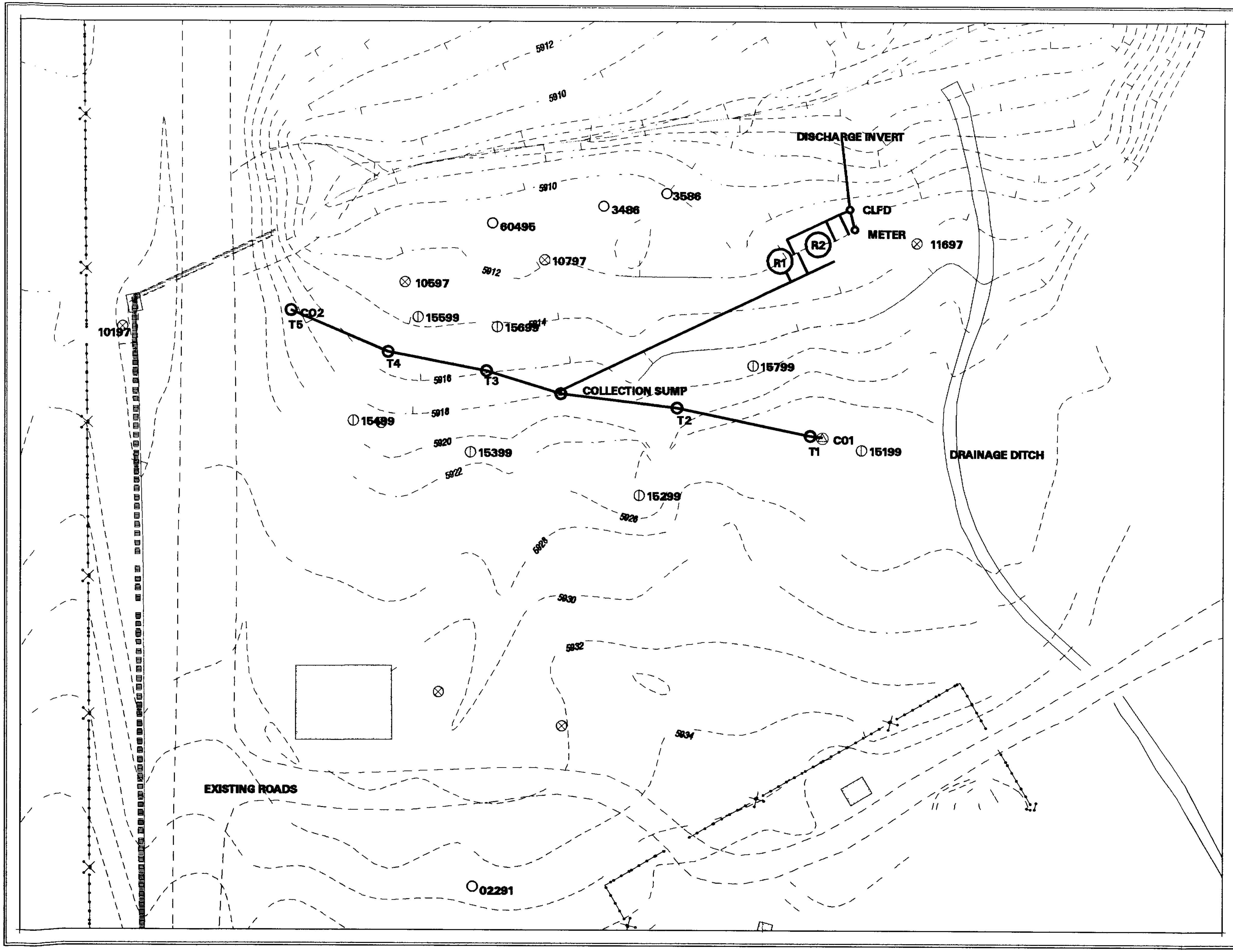
99-0223

BARRIER WALL AND TREATMENT SYSTEM LOCATIONS

Figure 1

Rocky Flats Environmental Technology Site



EXPLANATION

Detailed Key

- New Grou d Wat Well
- Existi g Grou d Water Well
- New Tr nch Water Level M itori g Probe
- Geoprobe
- New Tre h Cleanout
- Conto rs
- Fence
- 72 Culvert
- Trench System

Standard Map Features

- Build ng d othe struct re
- Lake nd pond
- Stre ms, ditch s, othe drain ge feature
- Paved road
- Dirt road

Scale = 1 490
1 inch represent approximat ly 41 feet

0 20 40ft

Stat Plane Coordinate Projectio
Colorado Central Zone
Dat m NAD27

U S Department of Energy
Rocky Flats Environmental Technology Site

Prepared by

RMRS Rocky Mountain Remediation Services, L.L.C.

MAP ID: 99-0223

June 10 1999

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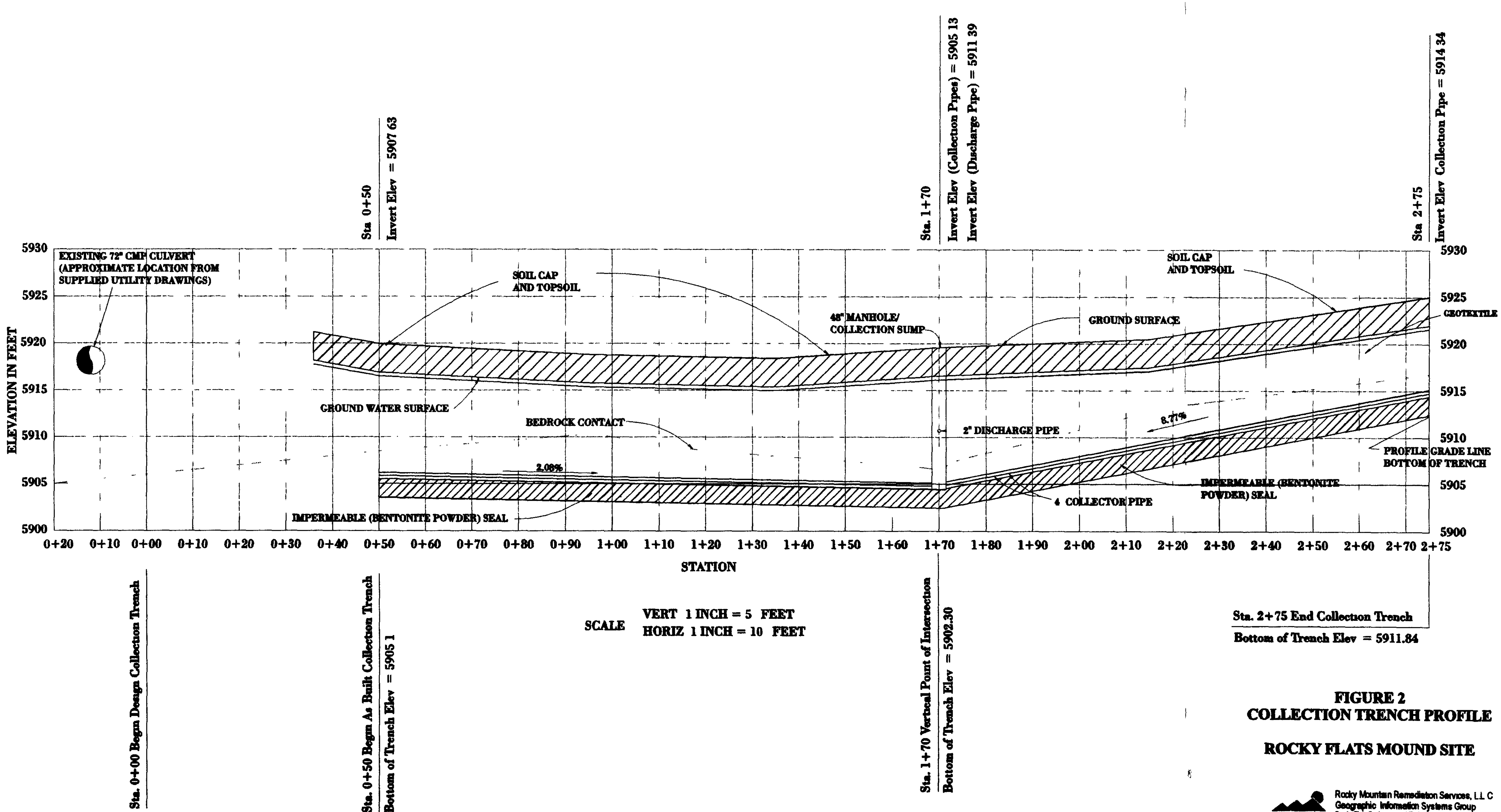

FIGURE 2
COLLECTION TRENCH PROFILE

ROCKY FLATS MOUND SITE

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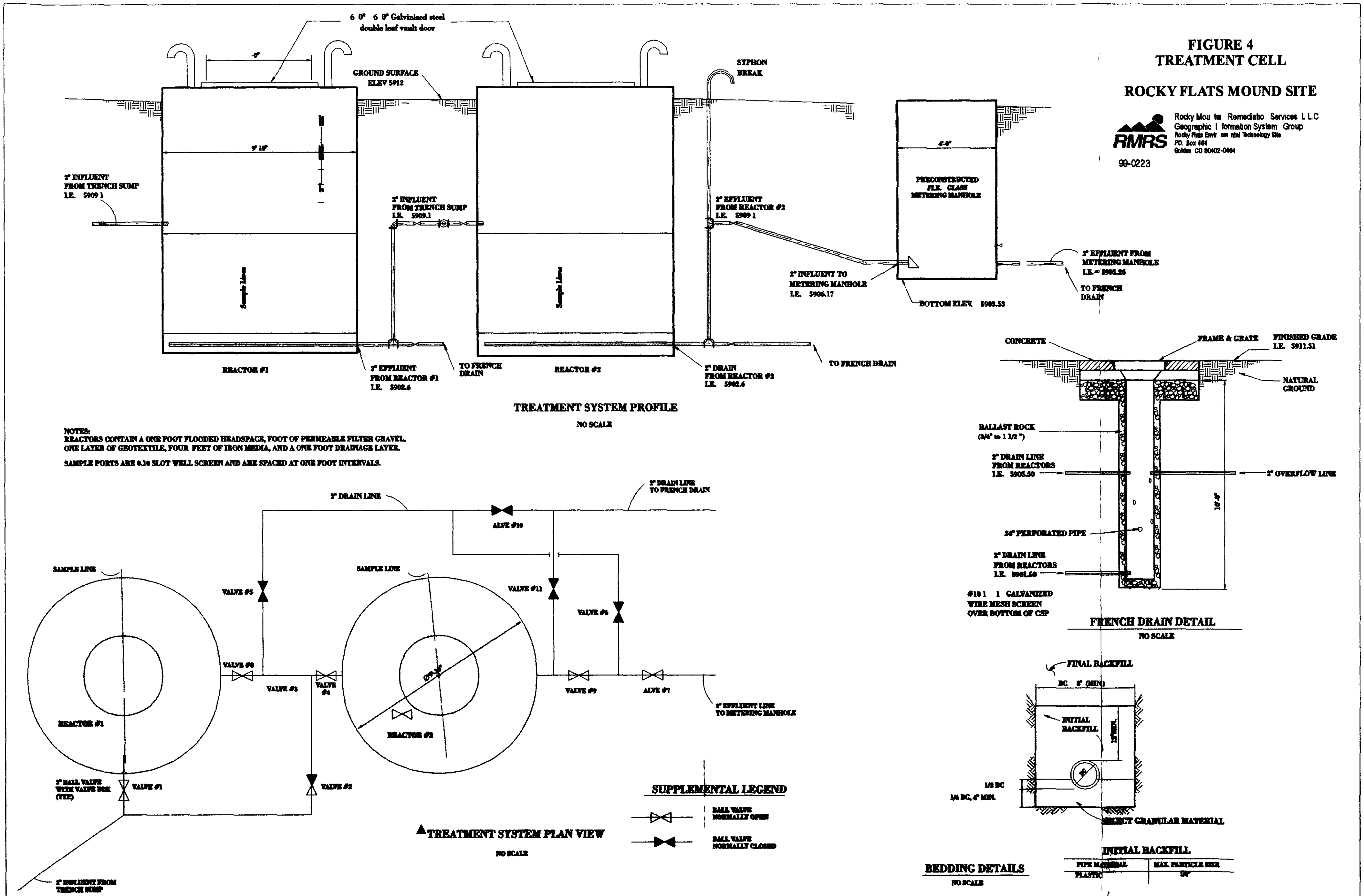

FIGURE 4
TREATMENT CELL

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